Brüel & Kjær

Type 4440

Gating System

Valid from serial no. 876709

037—0223

Service

Type 4440

Gating System

Valid from serial no. 876709

037—0223

Consisting of:

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Trouble Shooting

If some sort of trouble occurs in this instrument first check the DC working voltages from the Power Supply.

Then localize the trouble to a certain circuit block by means of the Checking Procedure.

When a fault has been found and remedied the voltages and adjustments influenced by the remedy must be rechecked and the Checking Procedure can be used again to tell whether all basic functions of the instrument are fulfilled.

The tolerances stated in the instructions can only be used as a guide for adjustment and control, but no deviations must be corrected without being sure that the tolerances of the instrument used for the adjustment are small enough to have no influence of the measurements.

The instructions in this manual are given purely as a guide for servicing the equipment. Some faults, as f. inst. small deviations in tolerances require for their correction special control equipment and extensive experience, and in these cases it is necessary to return the instrument to the factory.

Spare Parts

Please state type and serial number of the apparatus when spare parts are ordered.

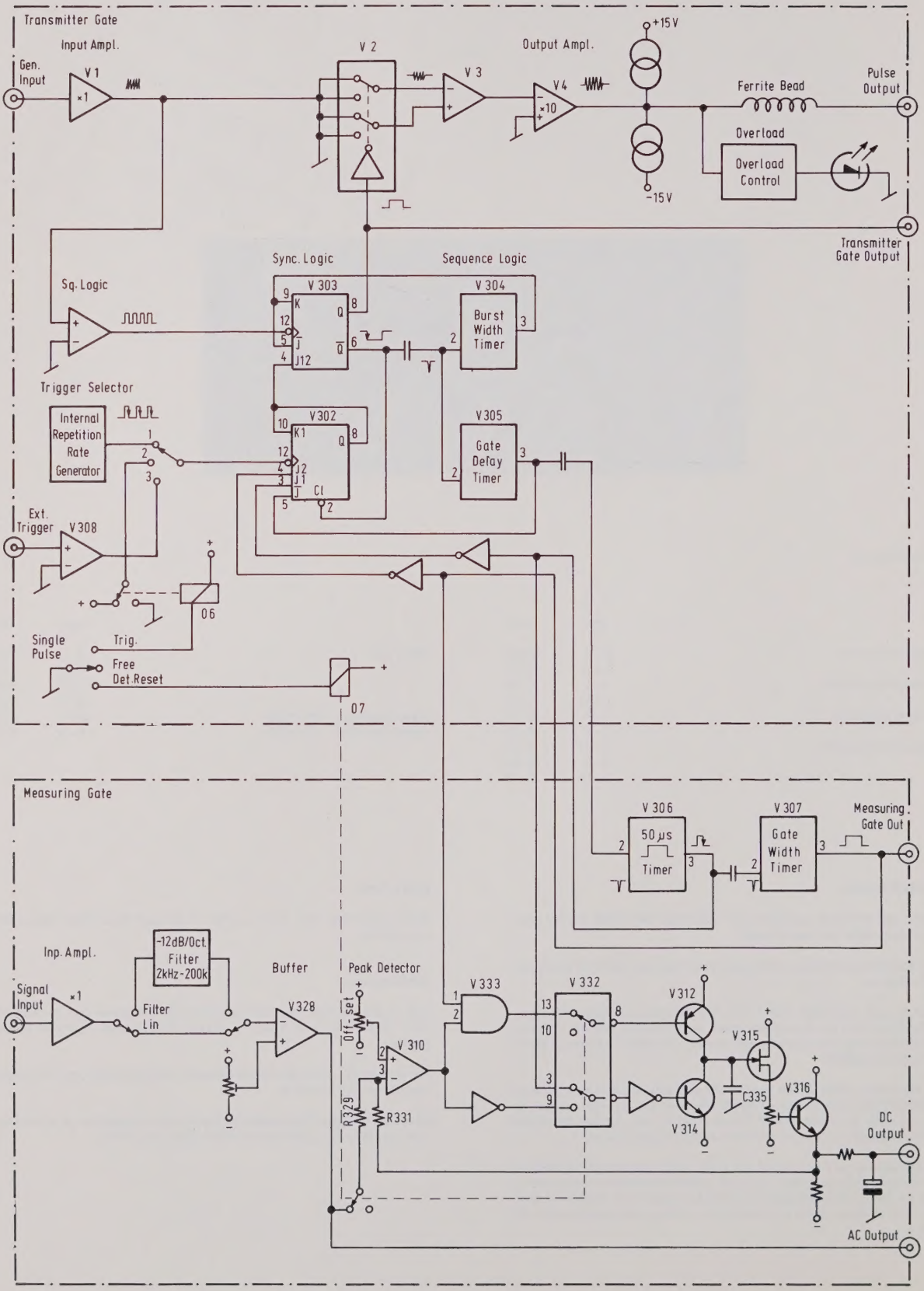
Modifications

Due to the constant technical progress the instrument will be modified from time to time in order to provide continuously improved performance.

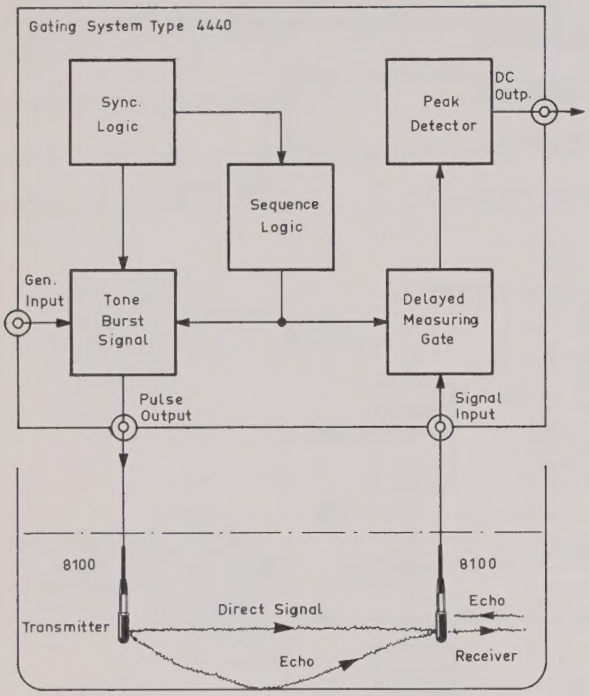
For this reason small deviations between the instrument and the Service Instruction may be found.

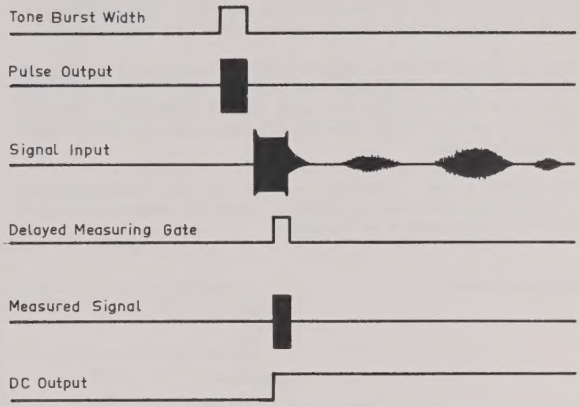
However, the local Representative Service is in possession of all information regarding the modifications which have been made.

Block Diagram



General





The Gating System Type 4440 is employed in transducer calibration applications where reflections are present. In order to avoid unwanted echoes the Gating System consists of a transmitter section where an adjustable tone burst signal is generated, and an adjustable measuring gate where the transmitted signal is inputted, thus disregarding unwanted echoes. The Sync. Logic maintains the processing of the two sections.

Generator Input

An external generator signal is applied via GEN. INP. to an input amplifier, the output of which is bursted by means of a MOS switch and an op. amp. (V 2 and V 3). The timing is provided from the Sync. Logic. Then the bursted signal is amplified 20 dB and emitted via PULSE OUT. A ferrite bead ensures a stabilized output signal.

Timing Logic

The tone burst signal should be emitted only when the Sequence Logic is in its idle position, that is, when the timers have expired. To obtain synchronization the Sync. Logic maintains that the start conditions are fulfilled.

The output of V 302 will change with every negative going trigger pulse provided J1 = J2 = 1 and J = 0 (Gate Delay and Gate Width timers are idle). So, whenever J = K = 0 of V 303 (Burst Width timer is idle) and J2 = 1, synchronization occur and the first negative going clock pulse will set the Q output high thus starting a sequence. As the clock pulse is derived from the Input Amplifier the burst will always start when the input signal is zero.

A high Q output will cause V 2 to gate the input signal to the PULSE OUT. Simultaneously the Burst Width and the Gate Delay timers are started while the flip-flop V 302 is cleared. When the Burst Width timer expires, K goes low and the next clock pulse will reset V 303, whereafter V 2 will inhibit the input signal.

The trailing edge of the Gate Delay timer fires a 50 μS timer used for discharging the Peak Detector, and then the Measuring Gate is established by the Gate Width timer.

Measuring Gate Input

The received signal passes via SIGNAL INPUT an input amplifier and a switch where a —12 dB/oct. filter may be inserted, through a buffer to the Peak Detector.

Peak Detector

The Peak Detector operates by charging the capacitor C 335 to the potentiel as is the max. negative peak. The incoming peaks are detected by the level of the — input of V 310. When the input signal from the Buffer becomes more negative than the feed-back from the capacitor the junction between R 329 and R 331 goes low forcing the output of V 310 high. Provided inside the Gate Width time the base of V 312 will go low thus charging the capacitor. The level will be reflected on the DC output through V 315 and V 316 and when the junction between the resistors is zero the output of V 310 goes low whereafter the charging will cease.

Prior to the opening of the Measuring Gate a 50 μS Timer is fired. Simultaneously the base of V 314 goes high and a discharge of C 335 will take place.

Single Pulse

When the instrument is operated in Single Pulse mode it might be useful to reset the output before a sequence is started. In this event V 332 will switch and V 312 and V 314 will be controlled directly from the output of V 310, hence the DC output will change around the off-set voltage and the signal input will be disregarded.

Notice, that when the Signal Input signal is constant a charge on C 335 will result when switching from Det. Reset to Free position. The reason is, that the selector V 332 is transferring the output of V 310 during Q 7's switch time.

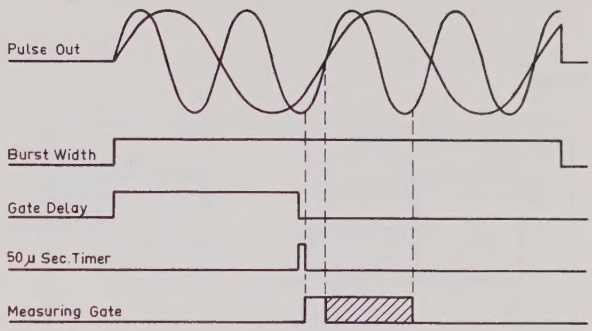
In the single pulse mode it is necessary to ensure that the Measuring Gate has the correct set-up.

From the figure it could be seen that the Measuring Gate will measure the correct value of one of the frequencies while the other has its maximum outside the gate. By adjusting either the Gate Delay or the Measuring Gate it is possible to get the correct DC value of the other frequency.

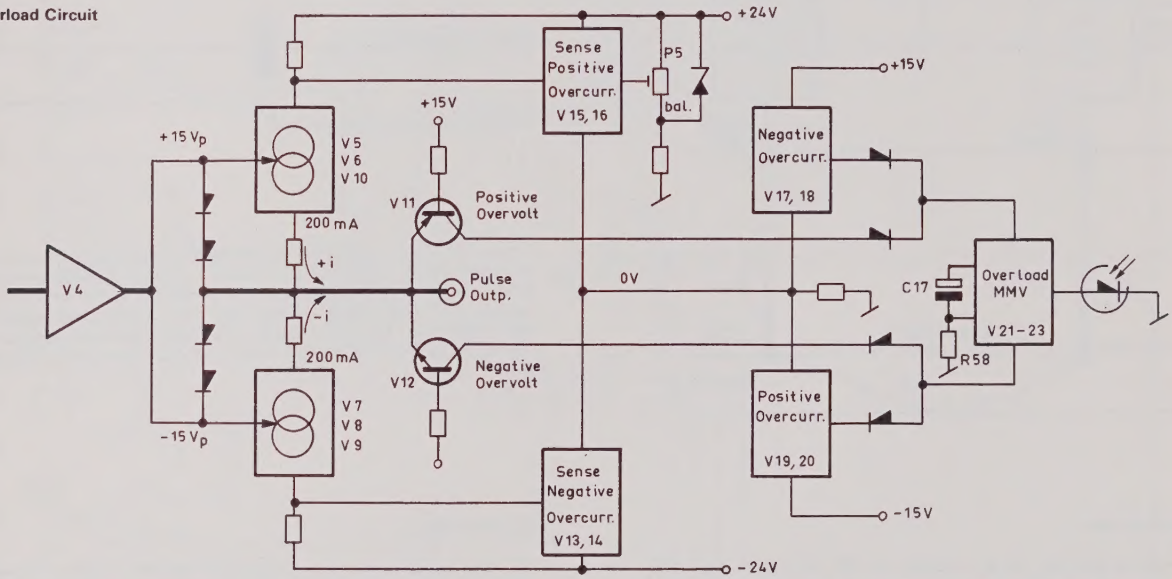
Thus, by calculate the timing it should be ensured that at least one maximum point is inside the Measuring Gate. Also an oscilloscope connected to the AC Output and the Measuring Gate Output will show the set-up.

Another thing is, that the charge of C 335 is dependent of the time constant which is approx. 35 μS. This means in praxis that when dealing with higher frequencies the max. peak may not be detected in one measurement, hence the single pulse has to be activated once more without a previous Det. Reset.

Notice, that a small "overshoot" will occur by high frequencies when charging from zero. This is, however, inside the tolerances of 0,5 dB which is the tolerance of the DC output.



Overload Circuit



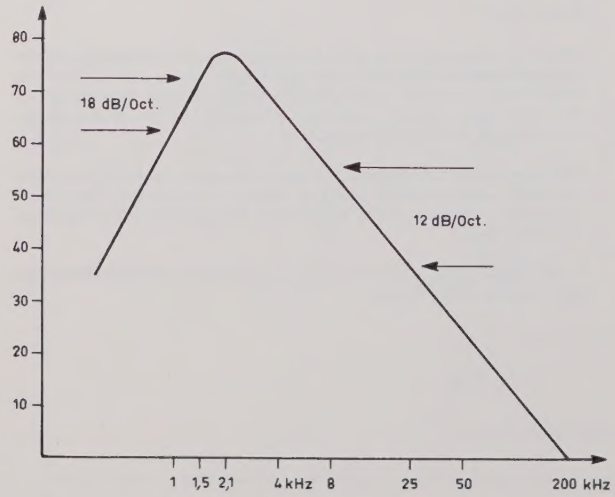
Just before the Pulse Output signal is overloaded the Overload circuit will be active. This happens when the output current exceeds 200 mA whether it be positive or negative or when the output voltage exceeds ± 15 V peak.

Two current generators are employed in order to provide the necessary output current. If more than 200 mA is demanded the voltage drop across R 19 or R 26 will increase so that the sense circuits will force the balanced 0 V line either + or —, resulting in an overcurrent signal to the Overload Timer.

Similarly, if the voltage exceeds 15 V peak V 11 or V 12 will give an overvoltage signal to the Overload Timer.

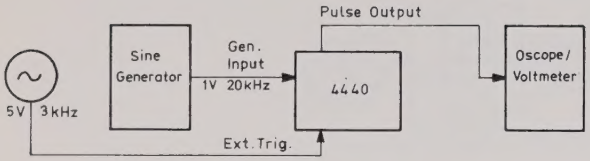
The Overload Timer is basically two transistors, V 21 and V 22 which both normally are "On". In case of an overload V 21 will go "off" forcing V 23 "On" in approx. 20 ms.

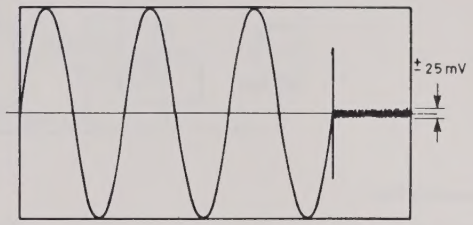
Filter



The filter acts as a bandpass filter. It might be useful when hydrophones are to be calibrated as it compensates a 12 dB/oct. rise in the signal occurring for frequencies from 2 — 200 kHz. In this way the resulting output will be averaged to give a resulting smooth frequency response.

Opposingly, below 2 kHz the signal should be cut-off. Therefore a usual R-C network are inserted before and after the bandpass filter resulting in a further 6 dB/oct. for frequencies below 2 kHz.





2.1. Transmiter Gate

Amplification

SINGLE PULSE FREE
TRIGGER SELECTOR: "Ext. Trig."
TRANSMITTER PULSE WIDTH: "300 ms × 1"
MEASURING GATE DELAY: "0,1 ms × 1"
MEASURING GATE WIDTH: "0,03 ms × 1"
LIN (rear panel)

Signal to "Gen. Input": 1 V, 20 kHz
Signal to "Ext. Trig.": 5 V, 3 kHz

Check the output on "Pulse Output": 10 V ± 1 V RMS.

TRANSMITTER PULSE WIDTH to: "1 ms × 1"

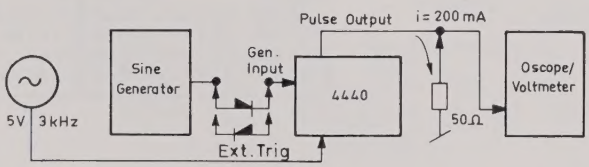
Adjust the oscilloscope to the above display. The noise between the bursts should be less than ± 25 mV.
The burst should be symmetrical around 0 V.
Spikes should be less than 500 mV peak.

Noise and Distortion

Adjust for 10 V, 20 kHz on "Pulse Output"

TRANSMITTER PULSE WIDTH to: "300 ms × 1"

Check noise and distortion: < 50 dB, (0,3%).



Overload

TRANSMITTER PULSE WIDTH, to "1 ms × 1"

Check that overload occur for an output voltage of + 14 V to + 15 V peak with a diode inserted between the Generator and "Gen. Input", frequency range 2 — 200 kHz.

Reverse the diode and check the negative overvoltage similarly.

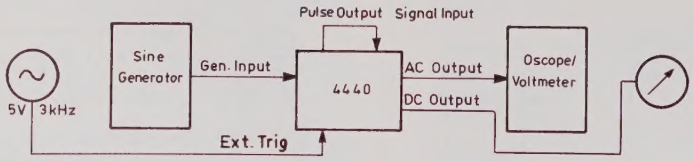
With a low input voltage connect a 50 Ω load to the output. Then increase the input voltage until overload occur. This should be above 10 V peak output corresponding to 200 mA and before the output signal is distorted for all frequencies from 2 — 200 kHz.

Then reverse the diode and check the positive overcurrent similarly.

TRIGGER SELECTOR to: "Intern Rate Gen."
TRANSMITTER PULSE RATE to: "× 0,5"

Remove diode and resistor

Signal to "Gen. Input": 1,8 V, 200 kHz.
Check that it is possible to see each overload which corresponds to approx. 20 mS.



2.2. Measuring Gate

SINGLE PULSE FREE
TRIGGER SELECTOR: "Ext. Trig."
TRANSMITTER PULSE WIDTH: "30 ms × 1"
MEASURING GATE DELAY: "10 ms × 1"
MEASURING GATE WIDTH: "0,03 ms × 1"
LIN (rear panel)

Signal to "Gen. Input": 250 mV, 20 Hz

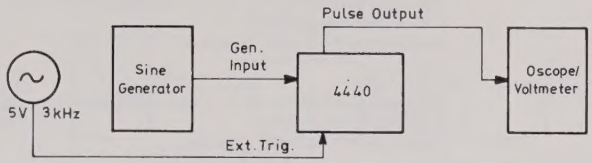
Vary the signal from 20 Hz to 200 kHz
Check the signal on "AC Output": 7 V pp ± 1 dB

Short circuit the "Signal Input" to ground. The DC level on both the "AC output" and the "DC output" should be 0 V.

to: FILTER (rear panel)

Check Filter Curve.

Signal to: "Signal Input"		"AC Output"
200 kHz	1 V (0 dB)	1 V
50 kHz	62,5 mV (—24 dB)	1 V ± 0,5 dB
4 kHz	0,4 mV (—68 dB)	1 V ± 1 dB
2,1 kHz	0,15 mV (—77 dB)	1 V + 1, —3 dB
1,5 kHz	0,25 mV (—72 dB)	1 V ± 1 dB



3.1. Transmitter Gate

Amplification

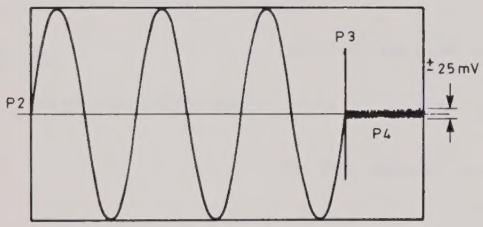
SINGLE PULSE FREE
TRIGGER SELECTOR: "Ext. Trig."
TRANSMITTER PULSE WIDTH: "1 ms × 1"
MEASURING GATE DELAY: "0,1 ms × 1"
MEASURING GATE WIDTH: "0,03 ms × 1"
LIN (rear panel)

Signal to "Gen. Input": 1 V , 20 kHz
Signal to "Ext. Trig.": 5 V, 3 kHz

Check that P1 (on ZE 0129) can vary the output signal 20 dB ± 1,5 dB

The output signal should be + 10 V ± 1 dB (14,14 V peak ± 1,6 V) with P1 left in its maximum.

Tone Burst Gate

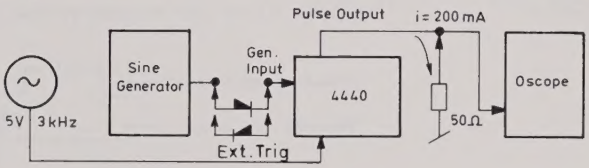


Set the oscilloscope to the shown display with the above setup.

Adjust P4 to min. noise between the bursts. It should be 0 ± 25 mV. (on ZE 0129)

Adjust P2 to a symmetrical burst around 0,V. (on ZE 0129)

Adjust P3 to min. spikes. It should be less than 500 mV peak. (on ZE 0129)



Overload Circuit

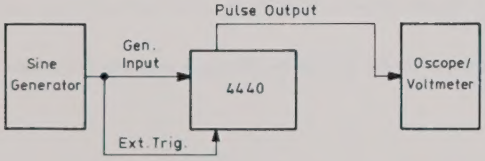
Signal to "Gen. Input": 1 V, 200 kHz

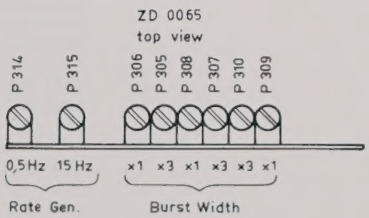
Insert a diode between the 2010 and Gen. Input.
Increase the input voltage until overload is just obtained. Then reverse the diode and repeat the procedure. The Overload Lamp should start at the same positive and negative value. If necessary adjust P5. (on ZE 0129)

Repeat the procedure until conformity is obtained. The Overload Lamp should start before the output signal is distorted for all frquencies from 2 — 200 kHz and range between ± 14 V and ± 15 V peak.

With a low input voltage connect a 50 Ω load to the output. Then increase the input voltage until overload occur. This should be at 10 V peak output corresponding to 200 mA. The tolerance is ± 10% for all frequencies from 2 — 200 kHz.

Reverse the diode and repeat the procedure.





TRIGGER SELECTOR, to: "Intern Rate Gen."
TRANSMITTER PULSE RATE, to: "0,5 Hz"
TRANSMITTER PULSE WIDTH, to: "0,1 ms × 1"

Signal to "Gen. Input": 4 V approx., 20 kHz
The Overload Lamp should go "on" 30 times ± 3 in one minut.
If necessary adjust P314.

TRANSMITTER PULSE RATE, to: "15 Hz"
Oscilloscope: "10 — 20 ms/cm"

The distance between the burst pulses should be 65 ms ± 10%.
If necessary adjust P315.

Burst Generator

Signal to " Gen. Input": 4 V approx., 20 kHz

TRIGGER SELECTOR, to: "Ext. Trig."
TRANSMITTER PULSE WIDTH, to: "10 ms ×1"
MEASURING GATE DELAY,to: "10 ms ×1"
MEASURING GATE WIDTH, to: "10 ms ×1"

The pulse burst should be 10 ms. Tolerances + 0, —10%.
If necessary adjust P306.
Oscilloscope Time Base: 1 ms/cm

TRANSMITTER PULSE WIDTH to: "10 ms × 3"
MEASURING GATE DELAY to: "300 ms ×1"

The pulse burst should be 31,6 ms. Tolerances + 10, —0%.
If necessary adjust P305.
Oscilloscope Time Base 10ms/cm

TRANSMITTER PULSE WIDTH to: "10 ms × 1"

Check that all range timing tolerances are inside the above 0 to 10%.

Measuring Gate Delay

The delay between the burst pulses should be 10 ms. Tolerances + 0, —10%.
If necessary adjust P308.

TRANSMITTER PULSE WIDTH, to: "0,1 ms × 1"
MEASURING GATE DELAY, to: "10 ms ×1"
MEASURING GATE WIDTH, to: "0,03 ms ×1"

MEASURING GATE DELAY to: "10 ms ×3"

The delay between the burst pulses should be 31,6 ms. Tolerances + 10,—0%.
If necessary adjust P307.
Oscilloscope Time Base 5 ms/cm

MEASURING GATE DELAY to: "10 ms × 1"

Check that all range delay tolerances are inside the above 0 to 10%.

Measuring Gate Width

The Gate Width should be 10 ms. Tolerances + 0, —10%.
If necessary adjust P309.

MEASURING GATE DELAY, to: "0,1 ms × 1"
MEASURING GATE WIDTH, to: "10 ms × 1"

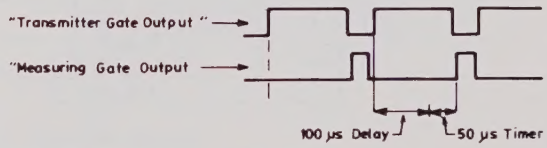
Oscilloscope Time Base 1 ms/cm

MEASURING GATE WIDTH to: "10 ms × 3"

The Gate Width should be 31,6 ms. Tolerances + 10, —0%.
If necessary adjust P310.
Oscilloscope Time Base: 5 ms/cm

MEASURING GATE WIDTH to: "10 ms × 1"

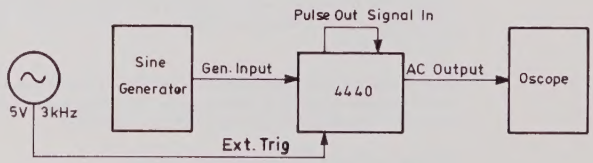
Check that all range width tolerances are inside the above 0 to 10%.



50 µs Timer

MEASURING GATE WIDTH, to: "0,03 ms × 1"

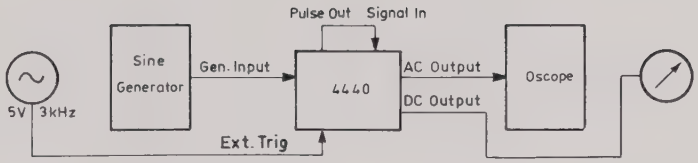
Check that the leading edge of the Measuring Gate is 150µs behind the leading edge of the Transmitter Pulse Output.
The tolerances are ± 10% of the last 50µs. (The first 100 µs is the Measuring Gate Delay.)
Oscilloscope Time Base: 50µs/cm



Linearity and DC off-set

Signal to "Gen. Input": 1 V, 20 Hz
Adjust C352 at 200 kHz to the same level as in 20 Hz. The total linearity 20 Hz — 200 kHz should be ± 1 dB. (on ZD 0165)

Short circuit the input to ground. The DC level on the AC output should be 0 V. If necessary adjust P313. (on ZD 0165)



Offset

TRANSMITTER PULSE WIDTH, to, "30 ms × 1"
MEASURING GATE DELAY, to: "10 ms × 1"
to: DETECTOR RESET

Short circuit "Signal Input" to ground.
Adjust P311 to 0 V on "DC Output". ("Offset Adj." rear panel)

Then connect the oscilloscope to C335 and adjust P312 to 0 V ± 0,5 V (on ZD 0065)

It may be necessary to repeat the above adjustments to obtain the right sensitivity of the Peak Detector.

to: SINGLE PULSE FREE

Signal to "Gen. Input": 7,1 V, 200 Hz.
Remove the short circuit and connect "Pulse Output" to "Signal Input".
Check by adjusting the "Gate Delay" that the DC output can vary from —3 V to + 7 V.

Linearity

MEASURING GATE WIDTH, to: "10 ms × 1"

Signal to "Gen. Input": 3 V approx., 200 Hz.
Adjust the signal to 3,16 V on "AC Output". By attenuating in 10 dB steps the linearity of the Peak Detector is checked according to the below table.

It may prove necessary to make a fine adjustment of P311 at 31,6 mV.

	AC Output	DC Output
0 dB	3,16 V	4,37 — 4,55 V
10 dB	1 V	1,38 — 1,44 V
20 dB	316 mV	370 — 455 mV

Cabinet parts can be found on page 4—4 where an exploded view describes the details.

Parts which are not mounted on the boards ZD 0065/ZE 0129 will be found under Miscellaneous

ZD 0065 Gate Generator

C 301	Polycarbonate			3,3 µF/100 V	CS 0347
C 302	Polystyrene			1 nF/ 63 V	CT 1546
C 319	-			510 pF/125 V	CT 1135
C 320	-			2 nF/ 63 V	CT 1123
C 321	-			220 pF/125 V	CT 0501
C 331	-			1 nF/ 63 V	CT 1546
C 332	-			1,5 nF/ 63 V	CT 1151
C 333	-			330 pF/125 V	CT 1144
C 334	Ceramic			47 pF/400 V	CK 1471
C 335	Polycarbonate			0,47 µF/100 V	CS 0383
C 336	Electrolytic			100 µF/ 16 V	CE 0310
C 337	Polycarbonate			2,2 µF/ 63 V	CS 0349
C 338	-			0,1 µF/250 V	CS 0402
C 339	Polystyrene			0,1 µF/ 63 V	CT 1543
C 340	Polycarbonate			4,7 µF/100 V	CS 0387
C 341	Polystyrene			620 pF/100 V	CT 1109
C 342	-			6,2 nF/ 63 V	CT 1510
C 343	Ceramic			47 pF/400 V	CK 1471
C 344	-			10 nF/400 V	CK 4100
C 345	Polystyrene			51 nF/ 63 V	CT 1542
C 346	Ceramic			150 pF/400 V	CK 2150
C 347	Polystyrene			1,25 nF/500 V	CT 1302
C 348	-			820 pF/ 63 V	CT 1532
C 349	-			4,7 nF/ 63 V	CT 1566
C 350	Ceramic			47 nF/ 30 V	CK 4470
C 351	-			150 pF/400 V	CK 2150
C 352	Trimmer			2,5-6 pF	CV 0050
C 353,354	Ceramic			33 pF/400 V	CK 1330
C 355	Polystyrene			300 pF/100 V	CT 1112
C 356,357	Tantalum			15 µF/ 20 V	CF 0010
C 359-370	-			15 µF/ 20 V	CF 0010
C 371,372	Ceramic			47 nF/ 30 V	CK 4470
C 373	Polystyrene			510 pF/125 V	CT 1135
C 374	Tantalum			15 µF/ 20 V	CF 0010
C 375,376	Ceramic			4,7 pF/400 V	CK 0470
C 377	-			5,6 pF/400 V	CK 0560
O 306,307	Relay			24 V	OC 0061
P 305	Trimmer	Cermet	lin.	1 MΩ	PG 5107
P 306	-	-	-	4,7 kΩ	PG 2471
P 307	-	-	-	1 MΩ	PG 5107
P 308,309	-	-	-	4,7 kΩ	PG 2471
P 310	-	-	-	1 MΩ	PG 5107
P 312	-	-	-	4,7 kΩ	PG 2471
P 313	-	-	-	10 kΩ	PG 3110
P 314	-	-	-	4,7 kΩ	PG 2471
P 315	-	-	-	22 kΩ	PG 3220
Q 301-306	Si.	BAX 16		150 V/300 mA	QV 0217
Q 307,308	-	13 P2		200 V/ 40 mA	QV 0022
Q 309-312	-	1N 4004		400 V/1 A	QV 0237
Q 313	Zener	ZM 12		11,4-12,6 V/1 W	QV 1313
Q 314	-	ZP 6,2		5,9-6,2 V/0,25 W	QV 1334
Q 315,316	Si.	BAX 16		150 V/300 mA	QV 0217
R 301	Carbon	1/4 W	5%	4,7 kΩ	RB 3470
R 302	-	-	-	1,2 MΩ	RB 6120
R 303	Metal	-	1%	267 kΩ	RF 5267
R 304	Carbon	-	5%	2,2 kΩ	RB 3220
R 305	-	-	-	22 kΩ	RB 4220
R 306	-	-	-	1,2 MΩ	RB 6120
R 307	Metal	-	1%	267 kΩ	RF 5267
R 308	Carbon	1/4 W	5%	2,2 kΩ	RB 3220
R 309-311	-	-	-	22 kΩ	RB 4220
R 312	-	-	-	2,2 kΩ	RB 3220
R 313	-	-	-	1,2 MΩ	RB 6120
R 314	Metal	-	1%	267 kΩ	RF 5267
R 315	Carbon	-	5%	1 kΩ	RB 3100
R 316	-	-	-	10 kΩ	RB 4100
R 317	-	-	-	15 kΩ	RB 4150
R 318	-	-	-	10 kΩ	RB 4100
R 319	-	-	-	1 MΩ	RB 6100
R 320,321	-	-	-	470 Ω	RB 2470
R 323,324	Metal	-	1%	1 kΩ	RF 3100
R 325	-	-	-	100 kΩ	RF 5100
R 326,327	-	-	-	10 kΩ	RF 4100
R 328	-	-	-	10 Ω	RF 1100
R 329	-	-	-	1 kΩ	RF 3100
R 330	-	-	-	487 Ω	RF 2487
R 331	-	-	-	1 kΩ	RF 3100
R 332	Carbon	-	5%	1 kΩ	RB 3100
R 333	-	-	-	4,7 kΩ	RB 3470
R 334	-	-	-	2,2 kΩ	RB 3220
R 335	-	-	-	15 kΩ	RB 4150
R 336	-	-	-	4,7 kΩ	RB 3470
R 337	-	-	-	1,5 kΩ	RB 3150
R 338	-	-	-	3 kΩ	RB 3300
R 339,340	-	-	-	2,2 kΩ	RB 3220
R 341	-	-	-	3,3 kΩ	RB 3330
R 342	Metal	-	1%	634 Ω	RF 2634
R 343	-	-	-	150 Ω	RF 2150
R 345	-	-	-	39,2 kΩ	RF 4392
R 346	Carbon	-	5%	2,2 kΩ	RB 3220
R 347	Metal	-	1%	10 Ω	RF 1100
R 348	-	-	-	1 kΩ	RF 3100
R 349	Carbon	-	5%	1 MΩ	RB 6100
R 350	-	-	-	56 kΩ	RB 4560
R 351	Metal	1/2 W	1%	5,62 kΩ	RF 0122
R 352	Carbon	1/4 W	5%	3,3 kΩ	RB 3330
R 353,354	-	-	-	1,5 kΩ	RB 3150
R 355,356	-	-	-	68 Ω	RB 1680
R 357,358	-	-	-	1 MΩ	RB 6100
R 359	Metal	-	1%	1,27 kΩ	RF 3127
R 360	-	-	-	39,2 kΩ	RF 4392
R 361	-	-	-	100 kΩ	RF 5100
R 362	Carbon	-	5%	27 kΩ	RB 4270
R 363	-	-	-	2,2 kΩ	RB 3220
R 364	-	-	-	1,8 kΩ	RB 3180
R 365	Metal	-	1%	39,2 kΩ	RF 4392
R 366	Carbon	-	5%	68 Ω	RB 1680
R 367	-	-	-	12 Ω	RB 1120
R 368	-	-	-	18 kΩ	RB 4180
R 369	-	-	-	1 kΩ	RB 3100
R 370	-	-	-	68 Ω	RB 1680
R 371	Metal	-	1%	953 Ω	RF 2953
R 372,373	-	-	-	78,7 kΩ	RF 4787
R 374	-	-	-	100 kΩ	RF 5100
R 375	-	-	-	19,1 kΩ	RF 4191
R 376	-	-	-	5,62 kΩ	RF 3562
R 377	-	-	-	10 Ω	RF 1100
R 378,379	-	-	-	10 kΩ	RF 4100
R 380	-	-	-	19,1 kΩ	RF 4191
R 381	Carbon	-	5%	47 Ω	RB 1470
R 382,383	-	-	-	1 kΩ	RB 3100
R 384,385	-	-	-	4,7 kΩ	RB 3470
R 386	-	-	-	6,8 kΩ	RB 3680
R 387	-	-	-	18 kΩ	RB 4180
R 388	-	-	-	2,2 kΩ	RB 3220
R 389,390	-	-	-	47 Ω	RB 1470
R 391	-	1/3 W	1%	150 Ω	
R 392	-	-	-	500 Ω	
R 393	-	1/4 W	5%	10 kΩ	RB 4100
R 394-396	-	1/8 W	10%	22 kΩ	RA 0010

4440.4 Parts List

V 301	Timer		NE 555	VD 0062
V 302,303	JK-Flip Flop		SN 7470	VD 0061
V 304-307	Timer		NE 555	VD 0062
V 308-310	Op. Amp.		LM 710 C	VE 0001
V 311	Si.	NPN	BSX 20	VB 0513
V 312	-	PNP	2N 2905	VB 0095
V 313	-	-	BC 177	VB 0071
V 314	-	NPN	2N 1613	VB 0026
V 315	FET	N	SI 442	VB 1018
V 316	Si.	NPN	BSX 20	VB 0513
V 317	-	-	BC 107	VB 0257
V 318	-	PNP	BC 177	VB 0071
V 319	-	NPN	BC 107	VB 0257
V 320	-	PNP	BC 177	VB 0071
V 321,322	-	NPN	BC 107	VB 0257
V 323,324	-	PNP	BC 177	VB 0071
V 325	-	NPN	BC 107	VB 0257
V 326	-	PNP	BC 177	VB 0071
V 327,328	Op. Amp.		LM 301	VE 0017
V 329	6 × Inverter Schmitt		SN7414	VD 1310
V 330	6 × Inverter		SN 7404	VD 0004
V 331	Si.	NPN	BC 107	VB 0257
V 332	2 × AND-OR-INV. Gate		SN 7450	VD 0020
V 333	4×2 Input Pos. AND Gate		SN 7408	VD 0029
	Printed Circuit Board			XC 1067
	Lock for Relay			SD 0014

ZE 0129 Gated Amplifier

C 1-3	Tantalum	15 µF/ 20 V	CF 0010
C 5	-	15 µF/ 20 V	CF 0010
C 7	Ceramic	15 pF/400 V	CK 1150
C 8	Polycarbonate	0,1 µF/250 V	CS 0044
C 9-11	Tantalum	15 µF/ 20 V	CF 0010
C 12	Ceramic	220 pF/ 63 V	CK 2221
C 15,16		820 pF/400 V	CK 2820
C 17	Tantalum	6,8 µF/ 35 V	CF 0009
C 18	-	15 µF/ 20 V	CF 0010
C 20	Electrolytic	2200 µF/ 35 V	CE 0452
C 21	Tantalum	15 µF/ 20 V	CF 0010
C 23	Electrolytic	2200 µF/ 35 V	CE 0452
C 24	Tantalum	15 µF/ 20 V	CF 0010
C 26	Electrolytic	1000 µF/ 16 V	CE 0309

P 1	Trimmer	Cermet	lin.	10 kΩ	PG 3110
P 2	-	-	-	1 kΩ	PG 2109
P 3	-	-	-	4,7 kΩ	PG 2471
P 4	-	-	-	2,2 kΩ	PG 2220
P 5	-	-	-	4,7 kΩ	PG 2471

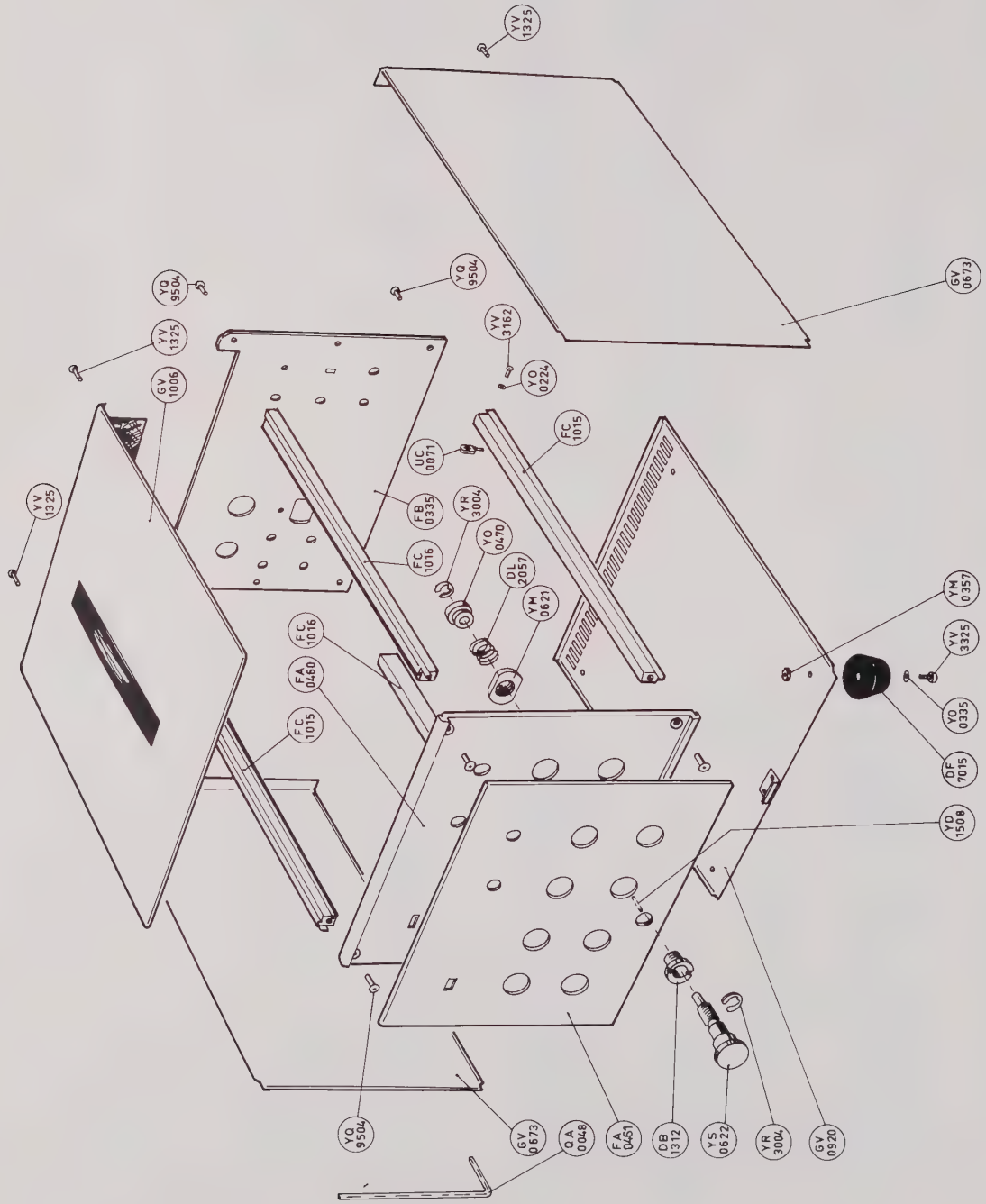
Q 1,2	Si.	BAX 16	150 V/300 mA	QV 0217
Q 5,6	Zener	ZF 3	2,8-3,2 V/0,25 W	QV 1341
Q 7-12	Si.	BAX 16	150 V/300 mA	QV 0217
Q 15,16	Zener	ZPD 6,2	5,9-6,5 V/0,25 W	QV 1334
Q 17-23	Si.	BAX 16	150 V/300 mA	QV 0217
Q 25-30	-	1N 4004	400 V/1 A	QV 0237

R 1	Metal	1/4 W	1%	1 kΩ	RF 3100
R 2	-	-	-	22,1 kΩ	RF 4221
R 3	-	-	-	3,16 kΩ	RF 3316
R 4	-	-	-	1 kΩ	RF 3100
R 5	-	-	-	2,49 kΩ	RF 3249
R 6,7	-	-	-	10 kΩ	RF 4100
R 8	-	-	-	825 Ω	RF 2825
R 9	-	-	-	2 kΩ	RF 3200
R 10	-	-	-	8,25 kΩ	RF 3825
R 11	-	-	-	750 Ω	RF 2750
R 12,13	-	-	-	26,7 kΩ	RF 4267
R 14	Carbon	1/4 W	5%	330 Ω	RB 2330
R 15	-	-	-	10 kΩ	RB 4100
R 16	-	-	-	120 Ω	RB 2120
R 17	-	1/2 W	-	250 Ω	
R 18	-	1/4 W	-	1 kΩ	RB 3100
R 19	Wire	1 W	2%	3,9 Ω	RR 0004
R 20	Carbon	1/4 W	5%	1,2 kΩ	RB 3120
R 21,22	Wire	1 W	-	1 Ω	RR 0001
R 23	Carbon	1/4 W	-	120 Ω	RB 2120
R 24	-	-	-	330 Ω	RB 2330
R 25	-	-	-	10 kΩ	RB 4100
R 26	Wire	1 W	2%	3,9 Ω	RR 0004
R 27	Carbon	1/2 W	5%	250 Ω	
R 28	-	1/4 W	-	1,2 kΩ	RB 3120
R 29	-	-	-	1 kΩ	RB 3100
R 30,31	-	-	-	3,3 kΩ	RB 3330
R 32	Metal	-	1%	9,09 kΩ	RF 3909
R 33	-	-	-	3,92 kΩ	RF 3392
R 34-36	Carbon	-	5%	3,3 kΩ	RB 3330
R 37	-	-	-	6,8 kΩ	RB 3680
R 38,39	-	-	-	2,7 kΩ	RB 3270
R 40-42	-	-	-	2,2 kΩ	RB 3220
R 43	Metal	-	1%	10 kΩ	RF 4100
R 44	Carbon	-	5%	2,2 kΩ	RB 3220
R 45	-	-	-	15 kΩ	RB 4150
R 46	-	-	-	12 kΩ	RB 4120
R 47	-	-	-	3,3 kΩ	RB 3330
R 48	-	-	-	2,2 kΩ	RB 3220
R 49	Metal	-	1%	10 kΩ	RF 4100
R 50	Carbon	-	5%	2,2 kΩ	RB 3220
R 51	-	-	-	15 kΩ	RB 4150
R 52	-	-	-	12 kΩ	RB 4120
R 53	-	-	-	2,7 kΩ	RB 3270
R 54	-	-	-	12 kΩ	RB 4120
R 55	-	-	-	10 kΩ	RB 4100
R 56	-	-	-	3,3 kΩ	RB 3330
R 57	-	-	-	1 kΩ	RB 3100
R 58	-	-	-	2,7 kΩ	RB 3270
R 59	-	-	-	12 kΩ	RB 4120

V 1	Voltage Follower		LM 310	VE 0023
V 2	MOS Analog switch		AH 0019	VE 0026
V 3,4	Op. Amp.		LM 318	VE 0050
V 5,6	Si.	PNP	BC 256	VB 0092
V 7,8	-	NPN	BC 174	VB 0537
V 9	-	PNP	40410	VB 0073
V 10	-	NPN	40409	VB 0509
V 11	-	PNP	BC 256	VB 0092
V 12,13	-	NPN	BC 174	VB 0537
V 14,15	-	PNP	BC 256	VB 0092
V 16	-	NPN	BC 174	VB 0537
V 17,18	Si.	NPN	BC 107	VB 0257
V 19,20	-	PNP	BC 177	VB 0071
V 21	-	NPN	BC 107	VB 0257
V 22	-	PNP	BC 177	VB 0071
V 23	-	NPN	BC 107	VB 0257
V 24	Pos. Voltage Reg.		LM 340K-15	VE 0056
V 25	Neg. Voltage Reg.		LM 320K-15	VE 0055
V 26	Pos. Voltage Reg.		LM 309K	VE 0022
V 27	Hex. Inverter		SN 7404	VD 0004
	Printed Circuit Board			XC 1066

Miscellaneous

C 303	Polystyrene			270 pF/125 V	CT 1143
C 304	-			940 pF/500 V	CT 1300
C 305	-			3,16 nF/125 V	CT 1164
C 306	-			10 nF/ 63 V	CT 1545
C 307	-			31,6 nF/ 63 V	CT 1548
C 308	-			100 nF/ 63 V	CT 1543
C 309	Polycarbonate			316 nF/ 50 V	CS 0240
C 310	-			1 µF/ 63 V	CS 0803
C 311	Polystyrene			270 pF/125 V	CT 1143
C 312	-			940 pF/500 V	CT 1300
C 313	-			3,16 nF/125 V	CT 1164
C 314	-			10 nF/ 63 V	CT 1545
C 315	-			31,6 nF/ 63 V	CT 1548
C 316	-			100 nF/ 63 V	CT 1543
C 317	Polycarbonate			316 nF/ 50 V	CS 0240
C 318	-			1 µF/ 63 V	CS 0803
C 322	Polystyrene			56 pF/ 63 V	CT 0137
C 323	-			270 pF/125 V	CT 1143
C 324	-			940 pF/500 V	CT 1300
C 325	-			3,16 nF/125 V	CT 1164
C 326	-			10 nF/ 63 V	CT 1545
C 327	-			31,6 nF/ 63 V	CT 1548
C 328	-			100 nF/ 63 V	CT 1543
C 329	Polycarbonate			316 nF/ 50 V	CS 0240
C 330	-			1 µF/ 63 V	CS 0803
J 201	BNC socket				JJ 0130
J 202	Coax. socket				JJ 0108
J 203	BNC socket				JJ 0130
J 301-306	BNC socket				JJ 0130
L 1	Ferrit bead				LH 0001
N 202	Power ON-OFF switch				NN 0014
N 303	Det. Reset — Single Pulse switch				NN 0050
O 201	Mains Voltage Selector				JS 0001
O 301	Filter — Lin. switch				NN 0031
O 302	Trigger switch				OH 2097
O 303	Burst Width				OH 2095
O 304	Gate Delay				OH 2095
O 305	Gate Width				OH 2096
P 301-304	Potentiometer	Carbon	lin.	1 MΩ	PP 5115
P 311	Trimmer	Wire	lin.	5 kΩ	PG 2515
Q 224	Overload LED			LD 30	QV 4004
T 201	Mains transformer				TN 0092
V 28	Fuse slow			125 mA	VF 0030
V 229	Lamp "Power"			220 V	VS 0024
	Mains Socket				OA 0037
	Knob 20 mm				SN 2022
	Stand-off				XL 0163
	Fuse, slow			80 mA	VF 0046


YY 1325
YQ 9504
GV 0673
YY 3162
YO 0224
YY 1325
GV 1006
FC 1015
UC 0071
YY 1325
FB 0335
YR 3004
YO 0470
FC 1016
DL 2057
YM 0621
YM 0357
FC 1016
YY 3325
FA 0460
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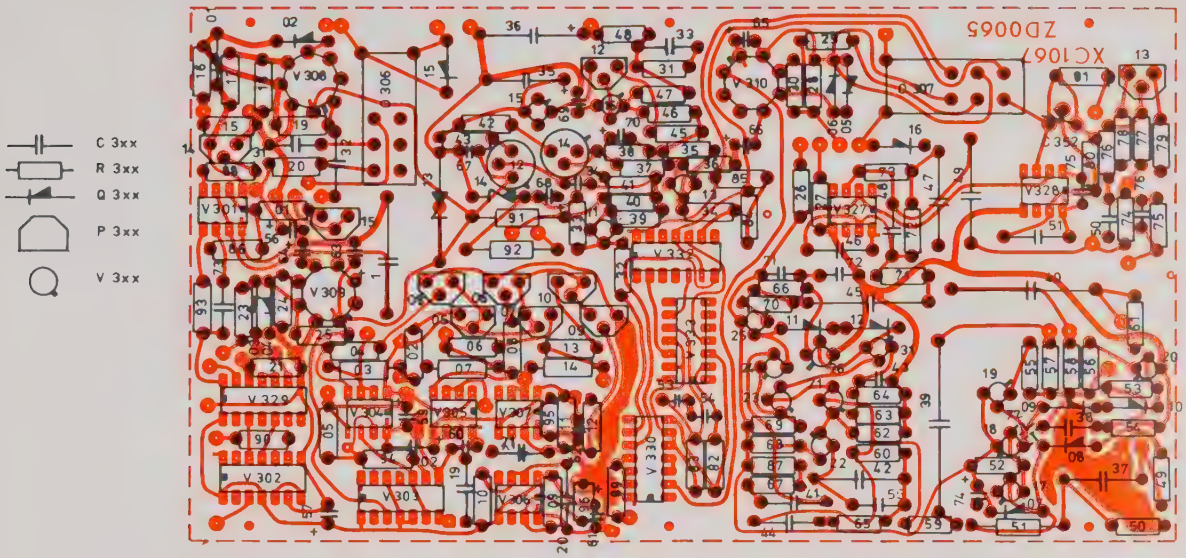
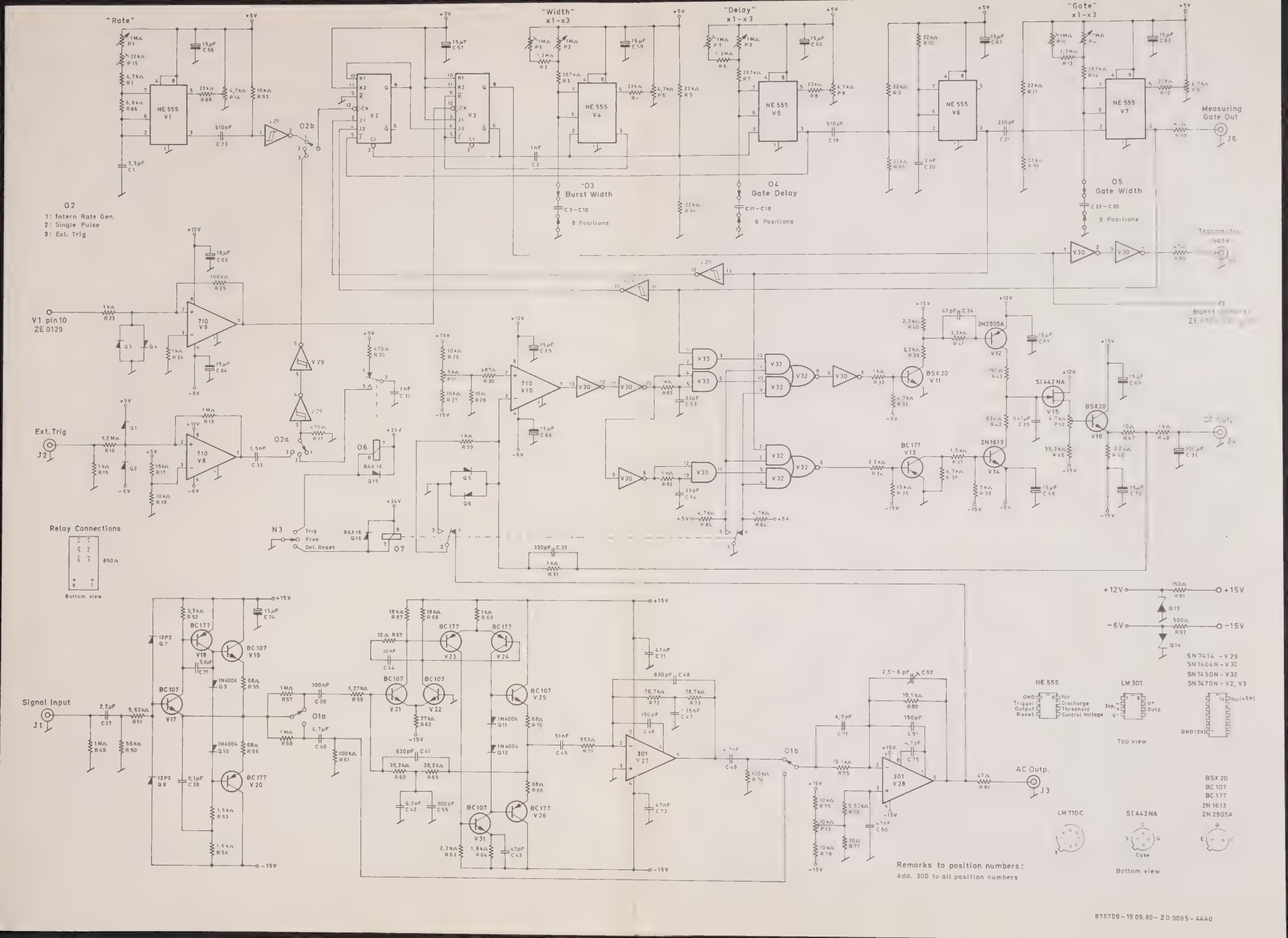
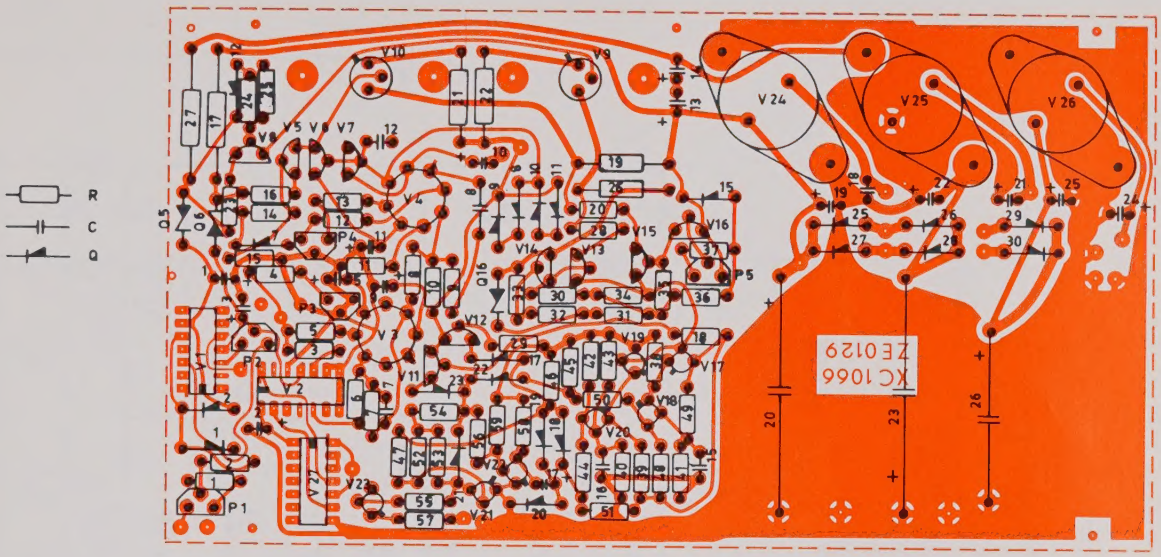


Viewed from the printed circuit side

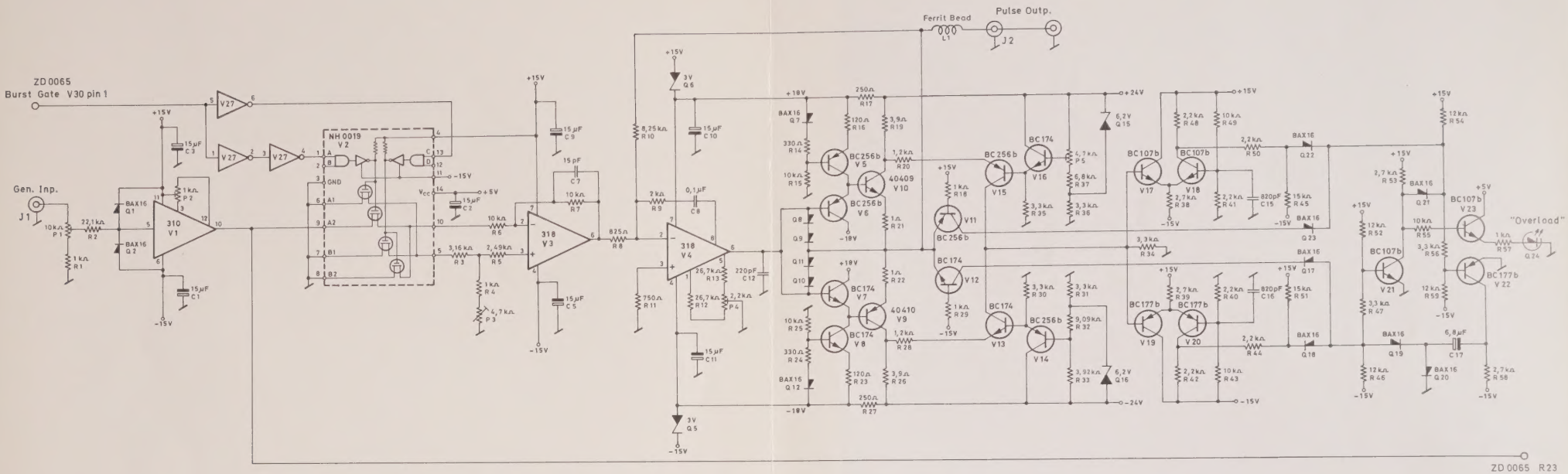
ZD 0065

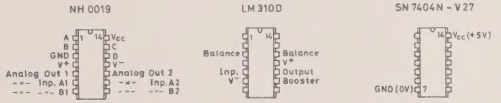

"Rate"
"Width" x1-x3
"Delay" x1-x3
"Gate" x1-x3
Measuring Gate Out
J6
O2
1: Intern Rate Gen.
2: Single Puise
3: Ext. Trig
O3 Burst Width
C3-C10
8 Positions
O4 Gate Delay
C11-C18
8 Positions
O5 Gate Width
C22-C30
9 Positions
V1 pin 10
ZE 0129
Ext. Trig
J2
Relay Connections
Bottom view
850Ω
N3
Trig
Free
Det. Reset
O7
Signal Input
J1
O1a
O1b
AC Outp.
J3
DC Outp.
J4
+12V
+15V
-6V
-15V
+5V
+24V
SN 7414 - V 29
SN 7404 N - V 30
SN 7450 N - V 32
SN 7470 N - V2, V3
NE 555
LM 301
Top view
LM 710 C
SI 442 NA
Bottom view
BSX 20
BC 107
BC 177
2N 1613
2N 2905A
Remarks to position numbers:
Add. 300 to all position numbers
876709 - 19.09.80 - ZD 0065 - 4440

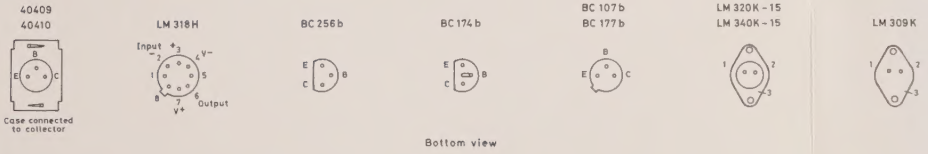


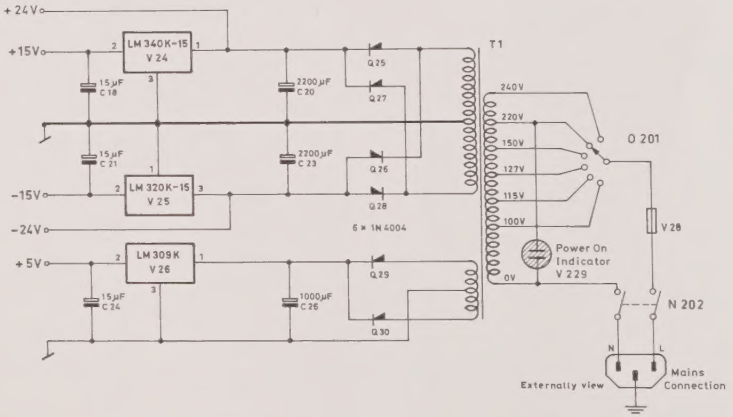
Viewed from the printed circuit side

ZE 0129









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MP MASTER
MA21675